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The Effect of Diethylstilbestrol on the Digestibility of Dry Matter and Nitrogen and on Nitrogen Retention in Lambs¹

By C. D. STORY, P. G. HOMEYER and W. H. HALE

Although the usefulness of orally administered diethylstilbestrol (stilbestrol) in increasing weight gains and feed efficiency of fattening cattle has been established, little is known concerning the mechanism by which it exerts its beneficial effect.

Two possible modes of action may exist. First, the stilbestrol may have some effect on the rumen microorganisms which might cause an increased digestion of feed in the rumen. Brooks *et al.* (1954) have shown that stilbestrol increased the digestibility of cellulose in the artificial rumen. They also obtained increased cellulose and protein digestion in sheep when stilbestrol was fed. However the levels fed the sheep were considerably above the mg. per lamb per day reported to be effective with lambs (Hale *et al.* 1955). Sykes *et al.* (1956) reported an increase in crude fiber digestibility and a decrease in protein digestibility with lactating cows when stilbestrol was fed. Digestibility of the dry matter of the ration tended to be improved but the differences were not statistically significant. Erwin *et al.* (1956) reported stilbestrol had no effect on digestibility of dry matter, crude fiber, crude protein or ether extract with steers.

Secondly, the orally fed stilbestrol may exert some action on the metabolism of the animal's tissue which is thought to occur when the stilbestrol is implanted (Clegg and Cole, 1954). It has been shown that implanted stilbestrol increased nitrogen retention but had no effect on ration digestibility (Jordan 1953: Whitehair *et al.* 1953). Bell *et al.* (1955) found that orally fed stilbestrol increased nitrogen retention in lambs. Presumably this action is brought about by the absorbed stilbestrol acting similar to that on the implanted stilbestrol.

The objectives of this report were to study the effects of different levels of stilbestrol upon the digestibility of dry matter and crude protein and on nitrogen retention with wether lambs.

EXPERIMENTAL

For this study 4 wether lambs each weighing about 80 pounds were used. Throughout the duration of the experiment the lambs were

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maintained individually. The experiment was divided into four periods as follows: Period 1—The lambs were fed a basal ration without stilbestrol; Period 2—The lambs were fed the basal ration plus 1 mg. stilbestrol per lamb per day; Period 3—The lambs were fed the basal ration plus 2 mg. stilbestrol per lamb per day; Period 4—The lambs were returned to the basal ration without stilbestrol. Within each period the lambs were on a given experimental ration for a total of 4 weeks, 3 weeks pre-collection and a 1 week collection. During pre-collection and collection periods the lambs were fed at the $1\frac{1}{4}$ maintenance level in order to secure complete and constant feed intake. Total collections were made by the usual techniques using fecal collection bags while the lambs were in the metabolism crates. The mixed ration fed the lambs was as follows: Ground alfalfa hay 50, cracked corn 33, cane molasses 15 and soybean oil meal 2. The stilbestrol was mixed with the rations in amounts to supply the 1 and 2 mg. levels.

The above design permitted each lamb to serve as his control and to determine if there was a carry-over effect from the stilbestrol supplementation. The average final weight of the lambs was 98 pounds.

Analysis of variance of the data was calculated according to Snedecor (1956).

RESULTS AND DISCUSSION

The data presented in all tables are an average of the four lambs for each period and as such are given on a per lamb basis for the collection period of 7 days.

The effect of stilbestrol on digestibility of dry matter is given in Table 1. It can be seen that increasing the level of stilbestrol increased the digestibility of the dry matter. During period 4 when the lambs were returned to the basal ration without stilbestrol the digestibility was only slightly above that during period 1. The increasing dry matter intake by periods was due to the increased weight of the lamb throughout the experiment as the lambs were fed at the $1\frac{1}{4}$ maintenance level during the last two weeks of each experimental period. The first two weeks of each experimental period the lambs were individually fed *ad libitum*. While these data on digestibility of dry matter are not necessarily in agreement with others, nevertheless, the information is not necessarily in conflict. In this experiment each lamb served as his control and was fed according to weight throughout the experiment. It is interesting to note that Erwin *et al.* (1956) reported no effect of stilbestrol on dry matter digestibility with steers but they also reported no beneficial effect upon growth rate by stilbestrol supplementation with these steers. It is assumed that part of the response noted with stilbestrol supplementation is due to an increased digestibility of the dry

matter of the ration, then if the animals failed to respond to stilbestrol supplementation an increase in dry matter digestibility would probably not be expected.

Table 1
Effect of Stilbestrol on Digestibility of Dry Matter by Lambs^a

	Period			
	1	2	3	4
Addition to basal ration.....	None	1 mg. DES ^b	2 mg. DES	None
Dry matter intake, gms.....	4752	5090	5171	7530
Fecal dry matter, gms.....	1432	1346	1153	2190
Apparent digestibility, percent ..	69.9	73.6 ^c	77.7 ^c	70.9

^aData in all tables on a per lamb basis for the 7-day collection period.

^bDES—diethylstilbestrol.

^cThe values for periods 2 and 3 are significantly higher than those for periods 1 and 4. $P = .05$.

The effect of stilbestrol on digestibility of nitrogen is given in Table 2. An increase in nitrogen digestibility is apparent, due to stilbestrol supplementation. During period 4 when the animals were returned to the basal ration digestibility of the nitrogen dropped below that of period 1. The reason for this cannot be explained. During period 4 the nitrogen intake was the highest of any period due to the weight of the animals. However, it is believed that this increased nitrogen intake is not responsible for the low nitrogen digestibility.

The results of the nitrogen balance study are presented in Table 3. During period 1 the lambs showed a slight positive nitrogen balance. Addition of stilbestrol enhanced nitrogen retention as can be seen during periods 2 and 3. It may be argued that this increased nitrogen retention is due to the increased nitrogen intake. This appears not to be the case if the results of period 4 are taken into consideration. In period 4, the animals were returned to the basal ration without stilbestrol. Nitrogen intake was the highest during this period due to the weight of the animals. However, it can readily be seen that nitrogen retention is very similar to that obtained during period 1. Calculations of protein intakes indicate that the protein intake of the lambs was slightly above maintenance during all periods. The increased nitrogen retention appears to be due to some

Table 2
Effect of Stilbestrol on Digestibility of Nitrogen by Lambs

	Period			
	1	2	3	4
Addition to basal ration.....	None	1 mg. DES ^b	2 mg. DES	None
Nitrogen intake, gms.....	98.9	106.9	121.4	134.8
Fecal nitrogen, gms.....	33.3	33.4	30.0	50.9
Apparent digestibility, percent ..	66.3	68.8 ^a	75.3 ^a	62.2

^aThe values for periods 2 and 3 are significantly higher than those for periods 1 and 4. $P = .05$.

Table 3
Effect of Stilbestrol on Nitrogen Retention by Lambs

	Period			
	1	2	3	4
Addition to basal ration.....	None	1 mg. DES	2 mg. DES	None
Nitrogen intake, gms.....	98.9	106.9	121.4	134.8
Fecal nitrogen, gms.....	33.3	33.4	30.4	50.9
Urinary nitrogen, gms.....	64.5	64.3	68.4	82.6
Nitrogen retained, gms.....	1.1	9.2	22.6	1.3
Nitrogen retained, percent.....	1.1	8.6	18.6	1.0
Absorbed nitrogen retained, percent	1.8	14.4 ^a	24.8 ^a	1.5

^aThe values for periods 2 and 3 are significantly higher than those for periods 1 and 4. P = .05.

metabolic effect rather than the fact that total protein level increased through the experiment due to increasing weight of the lambs.

Urine excretion of the lambs is given in Table 4. Urine output was greatly increased during period 3. During this period dry matter excretion by way of the urine increased. In terms of percent of dry matter consumed, dry matter excretion in the urine was increased by 58 per cent when compared to period 1. The increased dry matter excretion in the urine during period 3 is probably due to increased salt intake as salt was always available free choice even while the lambs were in the metabolism crates. An increased salt intake would be expected on the basis of the high urine excretion in order for the lambs to maintain proper osmotic relationships. In this connection it is interesting to note that Riggs *et al.* (1953) and Stanley (1949) reported an increased digestibility in the ration dry matter when salt intakes were high. This observance in relationship to the mode of action of stilbestrol needs further investigation.

Burroughs *et al.* (1955) reported an increased feed intake with steers fed stilbestrol supplements. It may well be that rate of digestion is enhanced by stilbestrol feeding and special techniques are necessary to show an increase in percentage digestion. It has been shown that certain materials will increase rate of digestion rather than per cent digested (Bentley *et al.* 1954; Clark and Quin, 1951; Becker and Smith, 1951).

Table 4
Effect of Stilbestrol on Urine Excretion by Lambs

	Period			
	1	2	3	4
Addition to basal ration.....	None	1 mg. DES	2 mg. DES	None
Urine voided, ml.....	6950	9714	17,037	7825
Total dry matter, gms.....	348	368	596	571
Urine dry matter Intake dry matter X100.....	7.3	7.2	11.5	7.5

SUMMARY

The effect of feeding diethylstilbestrol (stilbestrol) on digestion of ration dry matter and nitrogen and on nitrogen retention was investigated with wether lambs. Both 1 and 2 mg. of stilbestrol per lamb per day were fed. Both levels of stilbestrol feeding increased digestibility of dry matter and nitrogen when compared to the control period. Nitrogen retention was also increased by stilbestrol feeding. With each of the three factors studied, the 2 mg. level exerted a greater effect than did the 1 mg. level. The results of this study suggest that a part of the benefits of stilbestrol in lambs is due to increased digestion of ration nutrients as well as improved utilization of nitrogen in metabolism.

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